FORM PTO-1390 (Modified) (REV 11-98) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **R.36445**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): **09/889309**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE 00/04020	**14 November 2000**	**16 November 1999**

TITLE OF INVENTION

ELECTRIC DRIVE UNIT

APPLICANT(S) FOR DO/EO/US

LAUK, Detlef

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Transmittal Sheets in duplicate w/fees charged to Dep.Acct. 07-2100
Copy of German Text Application w/3 sheets drawings
Translation of German Text Application w/3 sheets drawings
Preliminary Amendment
Executed Declaration (not enclosed)
Assignment to Robert Bosch GmbH (not enclosed)
Copy of PCT/RO/101
Copy of PCT/ISA/210, 220

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/889309	PCT/DE 00/04020	R.36445

21. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1,000.00**	
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO **$860.00**	
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**	
☐	International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**	
☐	International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**	
	ENTER APPROPRIATE BASIC FEE AMOUNT =	**$860.00**
	Surcharge of **$130.00** for furnishing the oath or declaration later than ☒ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$130.00**

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	- 20 =	0	x $18.00	**$0.00**
Independent claims	- 3 =	0	x $80.00	**$0.00**
Multiple Dependent Claims (**check if applicable**).			☐	**$0.00**
	TOTAL OF ABOVE CALCULATIONS =			**$990.00**
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (**check if applicable**).			☐	**$0.00**
	SUBTOTAL =			**$990.00**
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).			+	**$0.00**
	TOTAL NATIONAL FEE =			**$990.00**
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (**check if applicable**).			☐	**$0.00**
	TOTAL FEES ENCLOSED =			**$990.00**
			Amount to be: refunded	$
			charged	$

☐ A check in the amount of to cover the above fees is enclosed.

☒ Please charge my Deposit Account No. **07-2100** in the amount of **$990.00** to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **07-2100** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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SIGNATURE

Ronald E. Greigg
NAME

31,517
REGISTRATION NUMBER

16 July 2001
DATE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Detlef LAUK

Based on PCT/DE 00/04020

For: Electric Drive Unit

PRELIMINARY AMENDMENT

Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE SPECIFICATION

Delete in their entirety pages 1, 2, 3, 4, 5, 6, 7, 10, and replace these pages with new pages 1, 2, 3, 4, 5, 6, 7, 10 attached hereto as Appendix 2.

Page 11, line 1, delete "Claims" and insert --I Claim--;

IN THE CLAIMS

Please cancel claims 1-17 and add new claims 18-42.

18. An electric drive unit (1), in particular for drives in a motor vehicle, comprising

an electric motor (15), having a rotor (20) with a shaft (28) and a pole housing (10),

said pole housing (10) including an end shield (43), a motor bearing (45) for the rotor (20), and at least one magnet (32) and a short-circuit element (36), and

a one- or multi-part gear housing (5), connected to said pole housing (10),

said pole housing (10) being in one piece with at least one part of said gear housing (5).

19. The electric drive unit of claim 18, wherein

the pole housing (10) is formed at least partly of plastic.

20. The electric drive unit of claim 18, wherein

the at least one magnet (32) is injected at least partly into the pole housing (10).

21. The electric drive unit of claim 18, wherein

the short-circuit element (36) forming a short circuit for the at least one magnet (32) is injected at least partly into the pole housing (10).

22. The electric drive unit of claim 18, wherein

the short-circuit element (36) comprises at least two shells.

23. The electric drive unit of claim 18, wherein

the short-circuit element (36) is embodied in one piece.

24. The electric drive unit of claim 18, wherein

the short-circuit element (36), comprising a mixture of plastic and magnetically conducted material, is injected into the pole housing (10).

25. The electric drive unit of claim 21, wherein

the short-circuit element (36) has a protrusion (65), which is surrounded by the plastic comprising the pole housing (10).

26. The electric drive unit of claim 18, wherein

the at least one magnet (32) has a protrusion (60) that is surrounded by the plastic comprising the pole housing (10).

27. The electric drive unit of claim 18, wherein

in the pole housing (10), the at least one magnet (32) is secured by positive engagement in the plastic of the pole housing (10) and by nonpositive engagement of the short-circuit element (36) located radially outward.

28. The electric drive unit of claim 18, wherein

in the pole housing (10), the short-circuit element (36) is secured by positive engagement in the plastic of the pole housing (10) and by nonpositive engagement of the radially inner magnet (32).

29. The electric drive unit of claim 18, wherein

the end shield (43) is embodied in one piece with the motor bearing (45),

and

the end shield (43) is insertable into the pole housing (10).

30. The electric drive unit of claim 18, wherein

the rotor (20) has an axial longitudinal axis (30), and

the end shield (43) for the rotor (20) is disposed, axially positionably, on the pole housing in order to adjust the longitudinal play of the armature.

31. The electric drive unit of claim 30, wherein

the end shield (43) is secured to the pole housing (10) by adhesive bonding.

32. The electric drive unit of claim 30, wherein

the end shield (43) is secured to the pole housing (10) by ultrasonic welding.

33. The electric drive unit of claim 30, wherein

the end shield (43) is secured to the pole housing (10) by a heat treatment.

34. The electric drive unit of claim 18, wherein

the shaft (28) is supported, oriented toward the gear housing (5), in an armature bearing (48) which is injected into the plastic of the pole housing (10).

35. The electric drive unit of claim 19, wherein

the at least one magnet (32) is injected at least partly into the pole housing (10).

36. The electric drive unit of claim 35, wherein

the short-circuit element (36) forming a short circuit for the at least one magnet (32) is injected at least partly into the pole housing (10).

37. The electric drive unit of claim 35, wherein

the short-circuit element (36) comprises at least two shells.

38. The electric drive unit of claim 36, wherein

the short-circuit element (36) is embodied in one piece.

39. The electric drive unit of claim 19, wherein

the short-circuit element (36), comprising a mixture of plastic and magnetically conducted material, is injected into the pole housing (10).

40. The electric drive unit of claim 20, wherein

the at least one magnet (32) has a protrusion (60) that is surrounded by the plastic comprising the pole housing (10).

41. The electric drive unit of claim 19, wherein

in the pole housing (10), the at least one magnet (32) is secured by positive engagement in the plastic of the pole housing (10) and by nonpositive engagement of the short-circuit element (36) located radially outward.

42. The electric drive unit of claim 19, wherein

in the pole housing (10), the short-circuit element (36) is secured by positive engagement in the plastic of the pole housing (10) and by nonpositive engagement of the radially inner magnet (32).

IN THE ABSTRACT

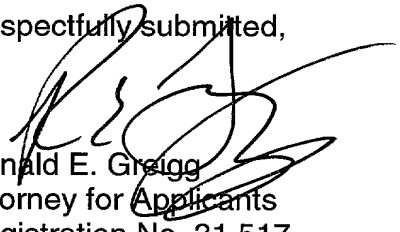
Please substitute the attached Abstract of the Disclosure for the original abstract as filed.

REMARKS

The above amendments are being made to place the application in better condition for examination.

Entry of the amendment is respectfully solicited.

Respectfully submitted,



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REG/JLB/emg

ABSTRACT OF THE DISCLOSURE

The invention relates to an electric drive unit having an electric motor, a gear, a gear housing, and a pole housing. A number of parts of the electric drive unit (1) and the production cost are both reduced by the integral embodiment of the gear housing (5) and pole housing (10) and by injection molding the short-circuit element (36) and magnet (32) into the pole housing (10). Such an electric drive unit (1) is used in windshield wiper motors or control motors in the automotive field.

Appendix 1, changes to the specification with brackets and underlining to show the changes that have been made:

Page 1,of the specification:

ELECTRIC DRIVE UNIT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a 35 USC 371 application of PCT/DE 00/04020 filed on November 14, 2000.

BACKGROUND OF THE INVENTION

[Prior Art] Field of the Invention

[The invention is based on an electric drive unit as generically defined by the preamble to claim 1.] The invention is directed to an electric drive unit and particularly to such drive units useful in motor vehicles.

Description of the Prior Art

Page 2, fifth paragraph, of the specification:

From German patent disclosure DE 197 24 920 A1, it is already known to accommodate a motor and a substantial portion of the gear in one housing[, in which the motor is also located]. A separate gear housing is always still necessary, however. Furthermore, this reference provides no information about how the motor is accommodated in the housing or what material comprises the housing.

Page 3, of the specification:

[Advantages of the Invention] SUMMARY OF THE INVENTION

The electric drive unit of the invention [having the characteristics of the body of claim 1] has the advantage over the prior art that in a simple way, the number of parts to be assembled and the production cost are reduced.

[By the provisions recited under dependent claims, advantages refinements of and improvements to the electric drive unit recited in claim 1 are possible.]

Pages 4-5, of the specification:

[Drawing] BRIEF DESCRIPTION OF THE DRAWINGS

[Exemplary embodiments of the invention are shown in simplified form in the drawing and described in further detail below.] Other features and advantages of the invention will become apparent from the detailed description contained below, taken in conjunction with the drawings, in which:

[Description of the Exemplary Embodiments] DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows a first exemplary embodiment of an electric drive unit 1 according to the invention. The electric drive unit 1 comprises a gear housing 5 and a pole housing 10. The gear housing 5 merges without any additional connection with the pole

housing 10, and the gear housing 5 can also be in multiple parts. For instance, a cap, not shown, and a bottom 6 can form the gear housing 5. The installation of a gear and optionally the installation of a bearing in the gear housing 5 is thus made possible because the cap is mounted later. The bottom 6 of the gear housing 5 in this example is in one piece with the pole housing 10. The gear housing 5 and the pole housing 10 can be of plastic or metal. If a housing 5, 10 is of plastic, then it is produced for instance by plastic injection or plastic casting. A [plastic] pole housing 10 of plastic can also be injection-molded onto a metal gear housing 5, so that any combination of materials is possible for the housings 5, 10. A worm drive 7, for instance, with a gear 8 not otherwise shown is located in the gear housing 5.

An electric motor 15 is located in the pole housing 10. The electric motor 15 comprises a stator 18 and a rotor 20. The rotor 20 is formed of an armature 22, a commutator 25, and a shaft 28. The shaft 28 has [an axial] a longitudinal axis 30.

The stator 18 comprises [two magnets 32.1, 32.2, for instance,] a magnet 32 and a short-circuit element 36. The magnet 32 can be in one piece or can comprise multiple parts 32.1, 32.2.

Page 6, of the specification:

The shaft 28 is supported at at least two points. On an end 40 of the shaft 28 toward the motor, an end shield 43 with a motor bearing 45 is present which initially is still axially adjustable. The end shield 43 and the motor bearing 45 can be embodied in one piece and can for instance be of plastic. The end shield 43 can also comprise

a metal motor bearing 45 [spring] spray-coated with plastic. One indentation 44, for example, is provided in the pole housing 10, and the end [shield 43] 40 of shaft 28 can be introduced into this indentation.

Page 7, of the specification:

In the production of the electric drive unit 1, magnets 32 (32.1, 32.2) and short-circuit elements 36, for instance, are placed in an injection molding tool and then, by injection of plasticized plastic into the injection-molding tool, the bottom 6 of the gear housing 5 and the pole housing 10 are formed.

The end shield 43 can for instance be screwed into a thread 57 present in the pole housing 10, or glued by a [worm] bead of adhesive, or joined to the pole housing 10 by ultrasonic welding or lasers. All this produces a watertight connection.

Given a suitable choice of material for the [bearing plate] end shield 43, the motor bearing 45 can not only perform radial support but can also absorb the axial run-up forces of the rotor 20. Furthermore, the end shield 43 with the motor bearing 45 can be pressed axially with slight prestressing force against a steel run-up cup 55 of the shaft 28 and be fixed to the pole housing 10 in an axially play-free state of the shaft 28.

Page 10, after the last paragraph insert the following paragraph:

The foregoing relates to preferred exemplary of embodiments of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, the latter being defined by the appended claims.

Appendix 2, new pages 1, 2, 3, 4, 5, 6, 7, 10 of the specification:

ELECTRIC DRIVE UNIT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a 35 USC 371 application of PCT/DE 00/04020 filed on November 14, 2000.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention is directed to an electric drive unit and particularly to such drive units useful in motor vehicles.

Description of the Prior Art

From German patent disclosure DE 32 35 622 A1 and US Patent 4,572,979, a design of an electric drive unit is known. Among other elements, it comprises an electric motor with a stator and a magnet in a pole housing, a rotor with an armature, and a gear in a gear housing. The pole housing and gear housing are joined together, making for a high number of parts to be assembled and high production costs.

The gear housing is made from plastic.

In the prior art, the motor housing either has a short-circuit element or is a pole housing that takes the form of a cup of a magnetically conductive material and thus acts as a short-circuit element. In both cases, two magnetic half shells are mounted on the inside in the housing. They are partly fixed by retention springs in the pole housing and/or, because of the incident vibration and also to reduce noise, they are adhesively bonded between the magnet and the pole housing.

The pole pot bottom contains a cylindrical or homelike bearing, which acts as a radial bearing for supporting the rotor.

After their manufacture, these parts, comprising an electric motor, magnet and bearing, exist in the form of separate components or a component group that have to be connected to the gear housing by screws or wedging.

Often, to reduce the longitudinal armature play, a spacer is also mounted between a face end of the rotor and a bearing in the pole housing, in order to compensate for tolerances of the rotor and pole housing.

From German patent disclosure DE 43 20 005 A1 and US Patent 5,895,207, it is already known to make the pole housing of an electric drive unit of plastic and for the magnets to be retained in the plastic. However, the gear housing and the pole housing are screwed together.

From German patent disclosure DE 197 24 920 A1, it is already known to accommodate a motor and a substantial portion of the gear in one housing. A separate gear housing is always still necessary, however. Furthermore, this reference provides no information about how the motor is accommodated in the housing or what material comprises the housing.

SUMMARY OF THE INVENTION

The electric drive unit of the invention has the advantage over the prior art that in a simple way, the number of parts to be assembled and the production cost are reduced.

The use of plastic for the housing is advantageous, because in this way, watertight pole and gear housings can be produced, and the weight of the drive unit can be reduced.

It is especially advantageous for magnets and/or a short-circuit element and/or an armature bearing to be injected into the pole housing, since this reduces the production cost and the number of parts to be assembled.

The use of a one-piece short-circuit element has advantages because it reduces the number of parts to be assembled.

It is also advantageous in the event of corrosion problems to spray-coat the short-circuit element with plastic on the outside.

By positive and nonpositive engagement, the at least one magnet or the short-circuit element can advantageously be secured in the pole housing, so that no further securing elements are necessary.

It is advantageous to keep the longitudinal armature play very slight by the insertion of an end shield with the motor bearing after a shaft has been installed.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will become apparent from the detailed description contained below, taken in conjunction with the drawings, in which:

Fig. 1 shows a first exemplary embodiment of a drive unit embodied according to the invention;

Figs. 2a-e show various possible ways of integrating the at least one magnet and the short-circuit element into the pole housing.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows a first exemplary embodiment of an electric drive unit 1 according to the invention. The electric drive unit 1 comprises a gear housing 5 and a pole housing 10. The gear housing 5 merges without any additional connection with

the pole housing 10, and the gear housing 5 can also be in multiple parts. For instance, a cap, not shown, and a bottom 6 can form the gear housing 5. The installation of a gear and optionally the installation of a bearing in the gear housing 5 is thus made possible because the cap is mounted later. The bottom 6 of the gear housing 5 in this example is in one piece with the pole housing 10. The gear housing 5 and the pole housing 10 can be of plastic or metal. If a housing 5, 10 is of plastic, then it is produced for instance by plastic injection or plastic casting. A pole housing 10 of plastic can also be injection-molded onto a metal gear housing 5, so that any combination of materials is possible for the housings 5, 10. A worm drive 7, for instance, with a gear 8 not otherwise shown is located in the gear housing 5.

An electric motor 15 is located in the pole housing 10. The electric motor 15 comprises a stator 18 and a rotor 20. The rotor 20 is formed of an armature 22, a commutator 25, and a shaft 28. The shaft has a longitudinal axis 30.

The stator 18 comprises a magnet 32 and a short-circuit element 36. The magnet 32 can be in one piece or can comprise multiple parts 32.1, 32.2.

The short-circuit element 36 can comprise two steel half-shells, for instance, or be in one piece, for instance comprising a steel ring, and can thus form the magnetic short

circuit for the magnets 32. The short-circuit element 36 can be made from any magnetically conductive material.

This may also be a mixture of plastic and a magnetically conductive material that is injected into the pole housing 10.

The at least one magnet 32 and the short-circuit element 36 are integrated with the pole housing 10.

The shaft 28 is supported at at least two points. On an end 40 of the shaft 28 toward the motor, an end shield 43 with a motor bearing 45 is present which initially is still axially adjustable. The end shield 43 and the motor bearing 45 can be embodied in one piece and can for instance be of plastic. The end shield 43 can also comprise a metal motor bearing 45 spray-coated with plastic. One indentation 44, for example, is provided in the pole housing 10, and the end 40 of shaft 28 can be introduced into this indentation.

Downstream of the electric motor 15, viewed in the direction of the gear housing, and in this case downstream of the commutator 25, for example, there is an armature bearing 48 which is injected for instance into the pole housing 10. A further bearing, a so-called gear bearing 50, is located on an end 53, toward the gear, of the shaft 28 in the gear housing 5. The end 53 toward the gear and the end 40 toward the motor of the shaft 28 are shaped as a run-up cup 55, for instance.

In the production of the electric drive unit 1, magnets 32 (32.1, 32.2) and short-circuit elements 36, for instance, are placed in an injection molding tool and then, by injection of plasticized plastic into the injection-molding tool, the bottom 6 of the gear housing 5 and the pole housing 10 are formed.

After the assembly of the rotor 20, gear 8, and so forth, the end shield 43 with the motor bearing 45 is inserted into the pole housing 10 axially in such a way that the longitudinal armature play is minimal. Shims to compensate for tolerances of the shaft and housings are unnecessary.

The end shield 43 can for instance be screwed into a thread 57 present in the pole housing 10, or glued by a bead of adhesive, or joined to the pole housing 10 by ultrasonic welding or lasers. All this produces a watertight connection.

Given a suitable choice of material for the end shield 43, the motor bearing 45 can not only perform radial support but can also absorb the axial run-up forces of the rotor 20. Furthermore, the end shield 43 with the motor bearing 45 can be pressed axially with slight prestressing force against a steel run-up cup 55 of the shaft 28 and be fixed to the pole housing 10 in an axially play-free state of the shaft 28.

recesses 72, for instance of stepped design, into which the magnet 32 and the short-circuit element 36 are inserted, located one above the other and secured. The plastic of the pole housing 10 surrounds the magnet 32 and the short-circuit element 36 completely toward the rotor 20. This increases a minimal spacing between the armature 20 and the magnet 32.

In Figs. 2a, b, c and e, the short-circuit element 36 is exposed on the outside, for the sake of better heat radiation. If corrosion has to be avoided, then this is done either by a suitable choice of material, or as in Fig. 2d, by spray-coating the outside of the short-circuit element 36.

To achieve a good, tight binding of the short-circuit element or short-circuit elements 36 to the pole housing 10, an appropriate peripheral region of the short-circuit elements 36 can be embodied in perforated or ribbed fashion, for instance. Vibration between the magnet 32 and the short- circuit element 36 cannot occur, since both the magnet 32 and/or the short-circuit element 36 are injected firmly into the pole housing or secured firmly in it.

In general, the described design is suitable for achieving watertight electric drive units, because the already tight plastic gear housing can also be welded in watertight fashion toward the gear to a plastic cap.

The foregoing relates to preferred exemplary of embodiments of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, the latter being defined by the appended claims.

ELECTRIC DRIVE UNIT

Prior Art

The invention is based on an electric drive unit as generically defined by the preamble to claim 1.

From German patent disclosure DE 32 35 622 A1 and US Patent 4,572,979, a design of an electric drive unit is known. Among other elements, it comprises an electric motor with a stator and a magnet in a pole housing, a rotor with an armature, and a gear in a gear housing. The pole housing and gear housing are joined together, making for a high number of parts to be assembled and high production costs.

The gear housing is made from plastic.

In the prior art, the motor housing either has a short-circuit element or is a pole housing that takes the form of a cup of a magnetically conductive material and thus acts as a short-circuit element. In both cases, two magnetic half shells are mounted on the inside in the housing. They are partly fixed by retention springs in the pole housing and/or, because of the incident vibration and also to reduce noise, they are adhesively bonded between the magnet and the pole housing.

The pole pot bottom contains a cylindrical or domelike bearing, which acts as a radial bearing for supporting the rotor.

After their manufacture, these parts, comprising an electric motor, magnet and bearing, exist in the form of separate components or a component group that have to be connected to the gear housing by screws or wedging.

Often, to reduce the longitudinal armature play, a spacer is also mounted between a face end of the rotor and a bearing in the pole housing, in order to compensate for tolerances of the rotor and pole housing.

From German patent disclosure DE 43 20 005 A1 and US Patent 5,895,207, it is already known to make the pole housing of an electric drive unit of plastic and for the magnets to be retained in the plastic. However, the gear housing and the pole housing are screwed together.

From German patent disclosure DE 197 24 920 A1, it is already known to accommodate a motor and a substantial portion of the gear in one housing, in which the motor is also located. A separate gear housing is always still necessary, however. Furthermore, this reference provides no information about how the motor is accommodated in the housing or what material comprises the housing.

Advantages of the Invention

The electric drive unit of the invention having the characteristics of the body of claim 1 has the advantage over the prior art that in a simple way, the number of parts to be assembled and the production cost are reduced.

By the provisions recited under dependent claims, advantages refinements of and improvements to the electric drive unit recited in claim 1 are possible.

The use of plastic for the housing is advantageous, because in this way, watertight pole and gear housings can be produced, and the weight of the drive unit can be reduced.

It is especially advantageous for magnets and/or a short-circuit element and/or an armature bearing to be injected into the pole housing, since this reduces the production cost and the number of parts to be assembled.

The use of a one-piece short-circuit element has advantages because it reduces the number of parts to be assembled.

It is also advantageous in the event of corrosion problems to spray-coat the short-circuit element with plastic on the outside.

By positive and nonpositive engagement, the at least one magnet or the short-circuit element can advantageously be secured in the pole housing, so that no further securing elements are necessary.

It is advantageous to keep the longitudinal armature play very slight by the insertion of an end shield with the motor bearing after a shaft has been installed.

Drawing

Exemplary embodiments of the invention are shown in simplified form in the drawing and described in further detail below.

Fig. 1 shows a first exemplary embodiment of a drive unit embodied according to the invention;

Figs. 2a-e show various possible ways of integrating the at least one magnet and the short-circuit element into the pole housing.

Description of the Exemplary Embodiments

Fig. 1 shows a first exemplary embodiment of an electric drive unit 1 according to the invention. The electric drive unit 1 comprises a gear housing 5 and a pole housing 10. The gear housing 5 merges without any additional connection with

the pole housing 10, and the gear housing 5 can also be in multiple parts. For instance, a cap, not shown, and a bottom 6 can form the gear housing 5. The installation of a gear and optionally the installation of a bearing in the gear housing 5 is thus made possible because the cap is mounted later. The bottom 6 of the gear housing 5 in this example is in one piece with the pole housing 10. The gear housing 5 and the pole housing 10 can be of plastic or metal. If a housing 5, 10 is of plastic, then it is produced for instance by plastic injection or plastic casting. A plastic pole housing 10 of plastic can also be injection-molded onto a metal gear housing 5, so that any combination of materials is possible for the housings 5, 10. A worm drive 7, for instance, with a gear 8 not otherwise shown is located in the gear housing 5.

An electric motor 15 is located in the pole housing 10. The electric motor 15 comprises a stator 18 and a rotor 20. The rotor 20 is formed of an armature 22, a commutator 25, and a shaft 28. The shaft 28 has an axial longitudinal axis 30.

The stator 18 comprises two magnets 32.1, 32.2, for instance, and a short-circuit element 36. The magnet 32 can be in one piece or can comprise multiple parts 32.1, 32.2.

The short-circuit element 36 can comprise two steel half-shells, for instance, or be in one piece, for instance comprising a steel ring, and can thus form the magnetic short

circuit for the magnets 32. The short-circuit element 36 can be made from any magnetically conductive material.

This may also be a mixture of plastic and a magnetically conductive material that is injected into the pole housing 10.

The at least one magnet 32 and the short-circuit element 36 are integrated with the pole housing 10.

The shaft 28 is supported at least two points. On an end 40 of the shaft 28 toward the motor, an end shield 43 with a motor bearing 45 is present which initially is still axially adjustable. The end shield 43 and the motor bearing 45 can be embodied in one piece and can for instance be of plastic. The end shield 43 can also comprise a metal motor bearing 45 spring-coated with plastic. One indentation 44, for example, is provided in the pole housing 10, and the end shield 43 can be introduced into this indentation.

Downstream of the electric motor 15, viewed in the direction of the gear housing, and in this case downstream of the commutator 25, for example, there is an armature bearing 48 which is injected for instance into the pole housing 10. A further bearing, a so-called gear bearing 50, is located on an end 53, toward the gear, of the shaft 28 in the gear housing 5. The end 53 toward the gear and the end 40 toward the motor of the shaft 28 are shaped as a run-up cup 55, for instance.

In the production of the electric drive unit 1, magnets 32 and short-circuit elements 36, for instance, are placed in an injection molding tool and then, by injection of plasticized plastic into the injection-molding tool, the bottom 6 of the gear housing 5 and the pole housing 10 are formed.

After the assembly of the rotor 20, gear 8, and so forth, the end shield 43 with the motor bearing 45 is inserted into the pole housing 10 axially in such a way that the longitudinal armature play is minimal. Shims to compensate for tolerances of the shaft and housings are unnecessary.

The end shield 43 can for instance be screwed into a thread 57 present in the pole housing 10, or glued by a worm of adhesive, or joined to the pole housing 10 by ultrasonic welding or lasers. All this produces a watertight connection.

Given a suitable choice of material for the bearing plate 43, the motor bearing 45 can not only perform radial support but can also absorb the axial run-up forces of the rotor 20. Furthermore, the end shield 43 with the motor bearing 45 can be pressed axially with slight prestressing force against a steel run-up cup 55 of the shaft 28 and be fixed to the pole housing 10 in an axially play-free state of the shaft 28.

Figs. 2a through 2e show various possible ways of integrating the at least one magnet 32 and the short-circuit element 36 into the pole housing 10. The same reference numerals as in Fig. 1 will be used for the same or identically functioning parts.

Fig. 2a shows that the magnet 32 has a first protrusion 60, which rests on a second protrusion 63, toward the rotor 20, of the pole housing 10 and thus forms a positive engagement with the plastic. The pole housing 10 is injection-molded for instance, around a third protrusion 65 of the short-circuit element 36, which is thus secured in the pole housing 10. The other ends of the magnet 32 and of the short-circuit element 36 are embodied similarly and are surrounded by the pole housing 10. The short-circuit element 36 and the magnet 32 rest tightly against one another, creating a nonpositive engagement for the magnet 32, which is retained on the second protrusion 63 of the pole housing 10.

Fig. 2b shows the magnet 32 with a first protrusion 60, which as in the case of the short-circuit element 36 in Fig. 2a protrudes into the pole housing 10 and is surrounded by plastic. In its plastic-surrounded third protrusion 65, the short-circuit element 36 has an opening 69, into which plastic penetrates in an injection-molding operation, for instance, and thus additionally secures the short-circuit

element 36 in the pole housing 10. In this example, an additional nonpositive engagement for the magnet 32 or the short-circuit element 36 is not necessary.

In Fig. 2c, the short-circuit element 36 rests with its third protrusion 65 on one side on a second protrusion 63 on a circumference of the pole housing 10, so that it forms a positive engagement with the plastic. The magnet 32 has a first protrusion 60, which protrudes into the pole housing 10 and radially secures the short-circuit element 36 by nonpositive engagement.

Fig. 2d shows how the pole housing 10 on the outside surrounds the circumference of the short-circuit element 36, for instance completely, and that the short-circuit element 36 has no protrusion and is secured in its position by positive engagement by the pole housing 10 and nonpositive engagement by the magnet 32. The magnet 32, as in Fig. 2b, is injected with the first protrusion 60 into the pole housing 10 and is provided with an opening 69 in the first protrusion 60.

The protrusions 60, 63, 65 extend completely or partially all the way around radially on at least one end face of the magnet 32 or of the short-circuit element 36.

The pole housing 10 can also be produced directly, without injection of the magnet 32 and the short-circuit element 36. Then, as shown in Fig. 2e, the pole housing has

recesses 72, for instance of stepped design, into which the magnet 32 and the short-circuit element 36 are inserted, located one above the other and secured. The plastic of the pole housing 10 surrounds the magnet 32 and the short-circuit element 36 completely toward the rotor 20. This increases a minimal spacing between the armature 20 and the magnet 32.

In Figs. 2a, b, c and e, the short-circuit element 36 is exposed on the outside, for the sake of better heat radiation. If corrosion has to be avoided, then this is done either by a suitable choice of material, or as in Fig. 2d, by spray-coating the outside of the short-circuit element 36.

To achieve a good, tight binding of the short-circuit element or short-circuit elements 36 to the pole housing 10, an appropriate peripheral region of the short-circuit elements 36 can be embodied in perforated or ribbed fashion, for instance. Vibration between the magnet 32 and the short-circuit element 36 cannot occur, since both the magnet 32 and/or the short-circuit element 36 are injected firmly into the pole housing or secured firmly in it.

In general, the described design is suitable for achieving watertight electric drive units, because the already tight plastic gear housing can also be welded in watertight fashion toward the gear to a plastic cap.

Claims

1. An electric drive unit (1), in particular for drives in a motor vehicle,

having an electric motor (15), which has a rotor (20) with a shaft (28) and has a pole housing (10),

wherein the pole housing (10) includes an end shield (43), with a motor bearing (45) for the rotor (20), and includes at least one magnet (32) and a short-circuit element (36),

and having a one- or multi-part gear housing (5), which is connected to the pole housing (10),

characterized in that

the pole housing (10) is in one piece with at least one part of the gear housing (5).

2. The electric drive unit of claim 1,

characterized in that

the pole housing (10) is at least partly of plastic.

3. The electric drive unit of claim 1 or 2,

characterized in that

the at least one magnet (32) is injected at least partly into the pole housing (10).

4. The electric drive unit of one or more of claims 1 through 3,

characterized in that

the short-circuit element (36) forming a short circuit for the at least one magnet (32) is injected at least partly into the pole housing (10).

5. The electric drive unit of one or more of claims 1 or 4,

characterized in that

the short-circuit element (36) comprises at least two shells.

6. The electric drive unit of one or more of claims 1 or 4,

characterized in that

the short-circuit element (36) is embodied in one piece.

7. The electric drive unit of one or more of claims 1, 2 or 4 through 6,

characterized in that

the short-circuit element (36), comprising a mixture of plastic and magnetically conducted material, is injected into the pole housing (10).

8. The electric drive unit of one or more of claims 4 through 7,

characterized in that

the short-circuit element (36) has a protrusion (65), which is surrounded by the plastic comprising the pole housing (10).

9. The electric drive unit of claim 1 or 3,

characterized in that

the at least one magnet (32) has a protrusion (60) that is surrounded by the plastic comprising the pole housing (10).

10. The electric drive unit of one or more of claims 1, 2 or 4 through 8,

characterized in that

in the pole housing (10), the at least one magnet (32) is secured by positive engagement in the plastic of the pole housing (10) and by nonpositive engagement of the short-circuit element (36) located radially outward.

11. The electric drive unit of one or more of claims 1, 2, 3, 5, 6 or 9,

characterized in that

in the pole housing (10), the short-circuit element (36) is secured by positive engagement in the plastic of the pole housing (10) and by nonpositive engagement of the radially inner magnet (32).

12. The electric drive unit of one or more of claims 1 through 4 or 7,

characterized in that

the end shield (43) is embodied in one piece with the motor bearing (45),

and

the end shield (43) is insertable into the pole housing (10).

13. The electric drive unit of one or more of claims 1 through 4, 7 or 12,

characterized in that

the rotor (20) has an axial longitudinal axis (30), and

the end shield (43) for the rotor (20) is disposed, axially positionably, on the pole housing in order to adjust the longitudinal play of the armature.

14. The electric drive unit of claim 13,

characterized in that

the end shield (43) is secured to the pole housing (10) by adhesive bonding.

15. The electric drive unit of claim 13 or 14,

characterized in that

the end shield (43) is secured to the pole housing (10) by ultrasonic welding.

16. The electric drive unit of one or more of claims 13 through 15,

characterized in that

the end shield (43) is secured to the pole housing (10) by a heat treatment.

17. The electric drive unit of one or more of the foregoing claims,

characterized in that

the shaft (28) is supported, oriented toward the gear housing (5), in an armature bearing (48) which is injected into the plastic of the pole housing (10).

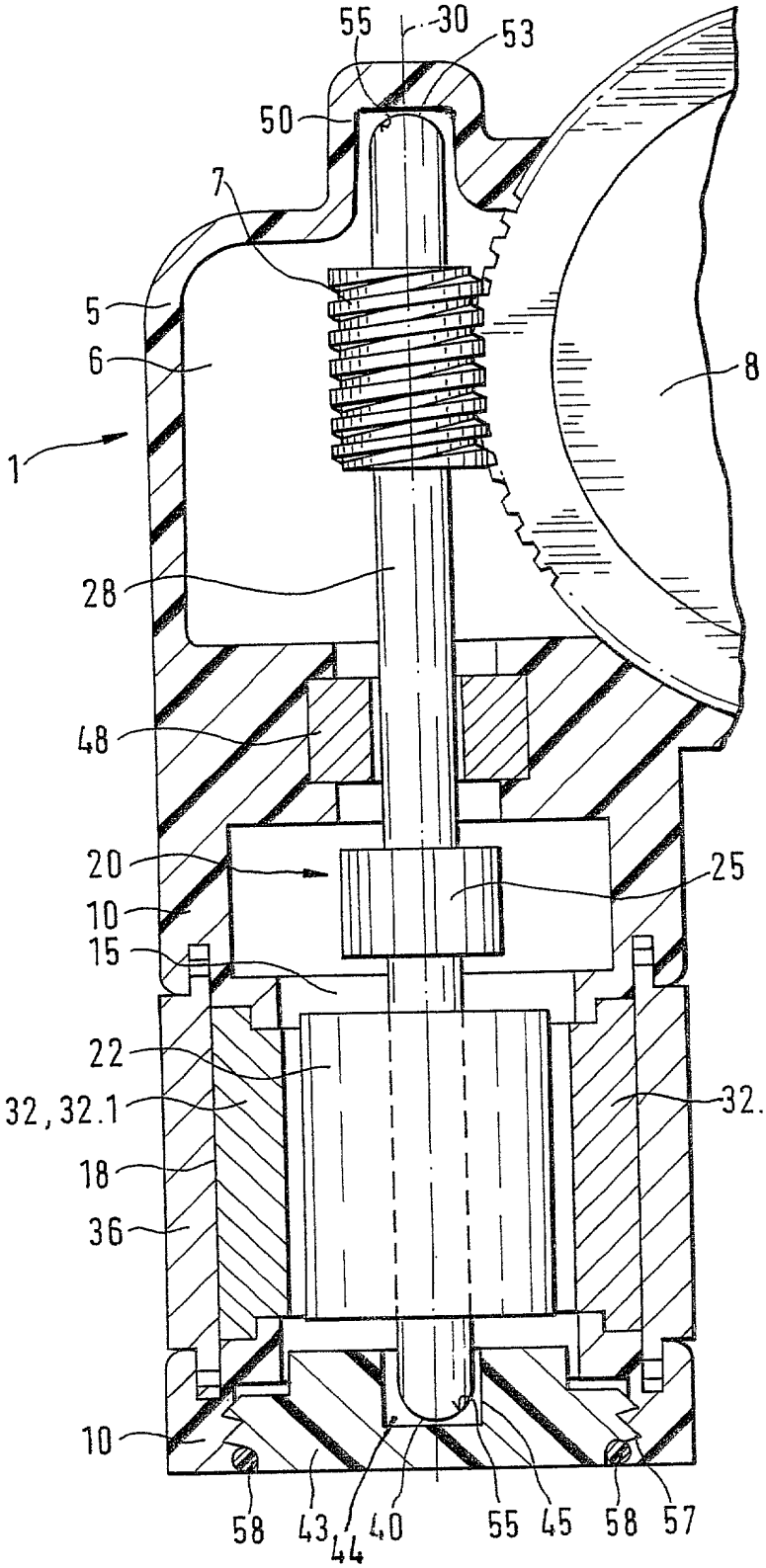

Fig.1

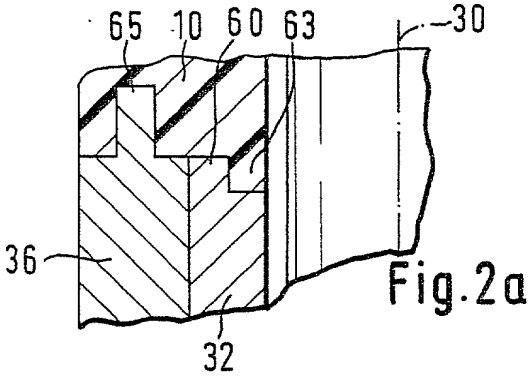

Fig.2a

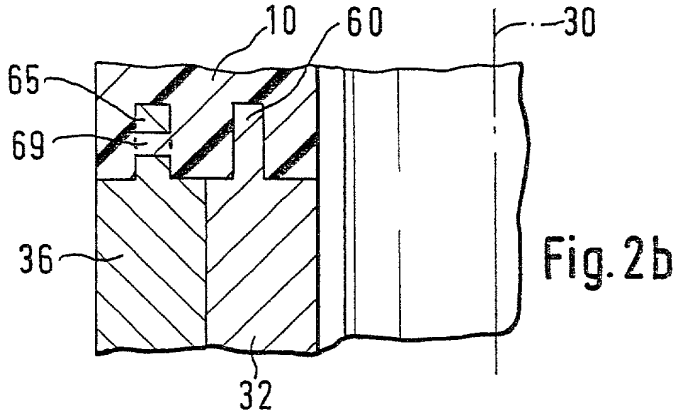

Fig.2b

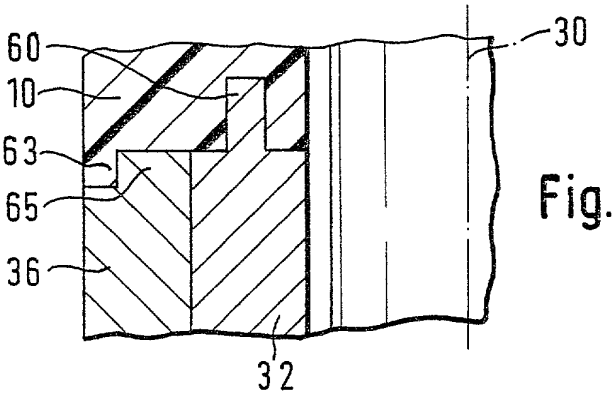

Fig.2c

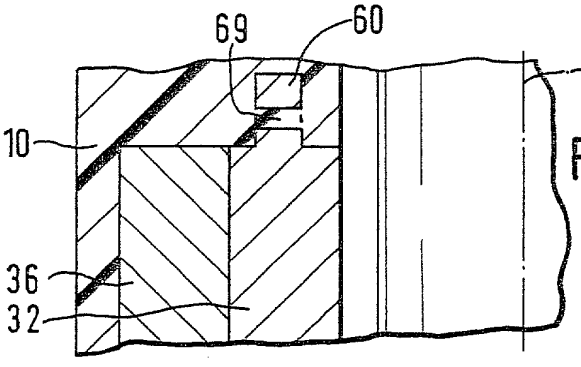

Fig.2d

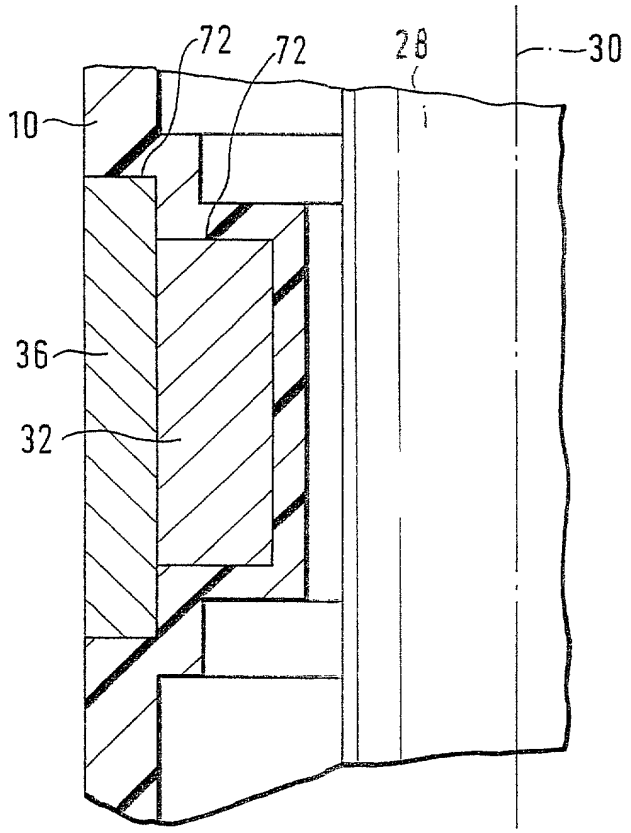

Fig. 2e

Docket No.
R.36445

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

ELECTRIC DRIVE UNIT

the specification of which

(check one)

☐ is attached hereto.

☒ was filed on 14 NOVEMBER 2000 as United States Application No. or PCT International Application Number PCT/DE 00/04020

and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Claimed
1 99 54 966.4	GERMANY	16 NOVEMBER 1999	☒
(Number)	(Country)	(Day/Month/Year Filed)	
			☐
(Number)	(Country)	(Day/Month/Year Filed)	
			☐
(Number)	(Country)	(Day/Month/Year Filed)	

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

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Second inventor's signature	Date
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Citizenship	
Post Office Address	